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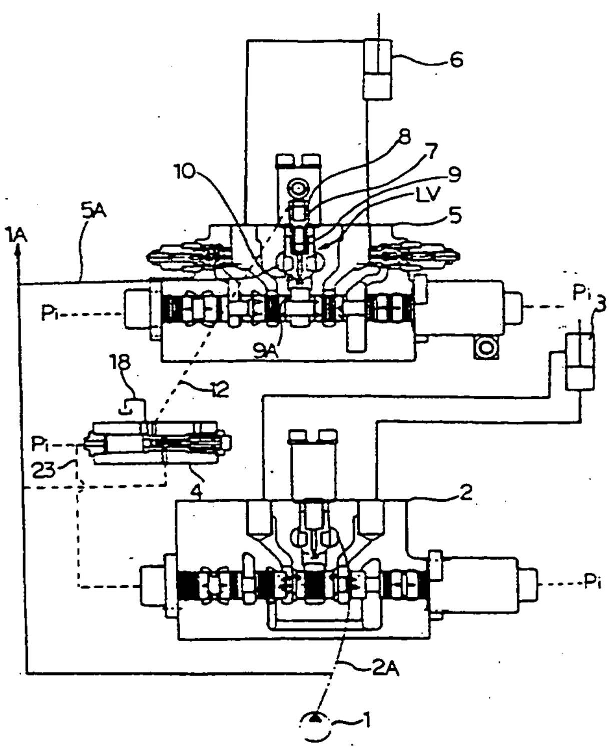
(54) **Variable priority device for hydraulic system of construction equipment**

(57) A variable priority device for a hydraulic system of construction equipment is disclosed. The device has a sequence valve 4 capable of sensing the pilot pressure for a high-load actuator control valve 2 and applying a control pressure to a logic valve LV so as to temporarily stop a low-load actuator 6 until the pilot pressure reaches a preset pressure capable of starting a high-load actuator 3. The device also controls the orifice area of the logic valve LV by feedback pressure and reduces the delay time between the starting of the low-load actuator 6 and the starting of the high-load actuator 3, thus allowing the two actuators to be started almost simultaneously and improving work efficiency of the construction equipment.

FIG.3



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

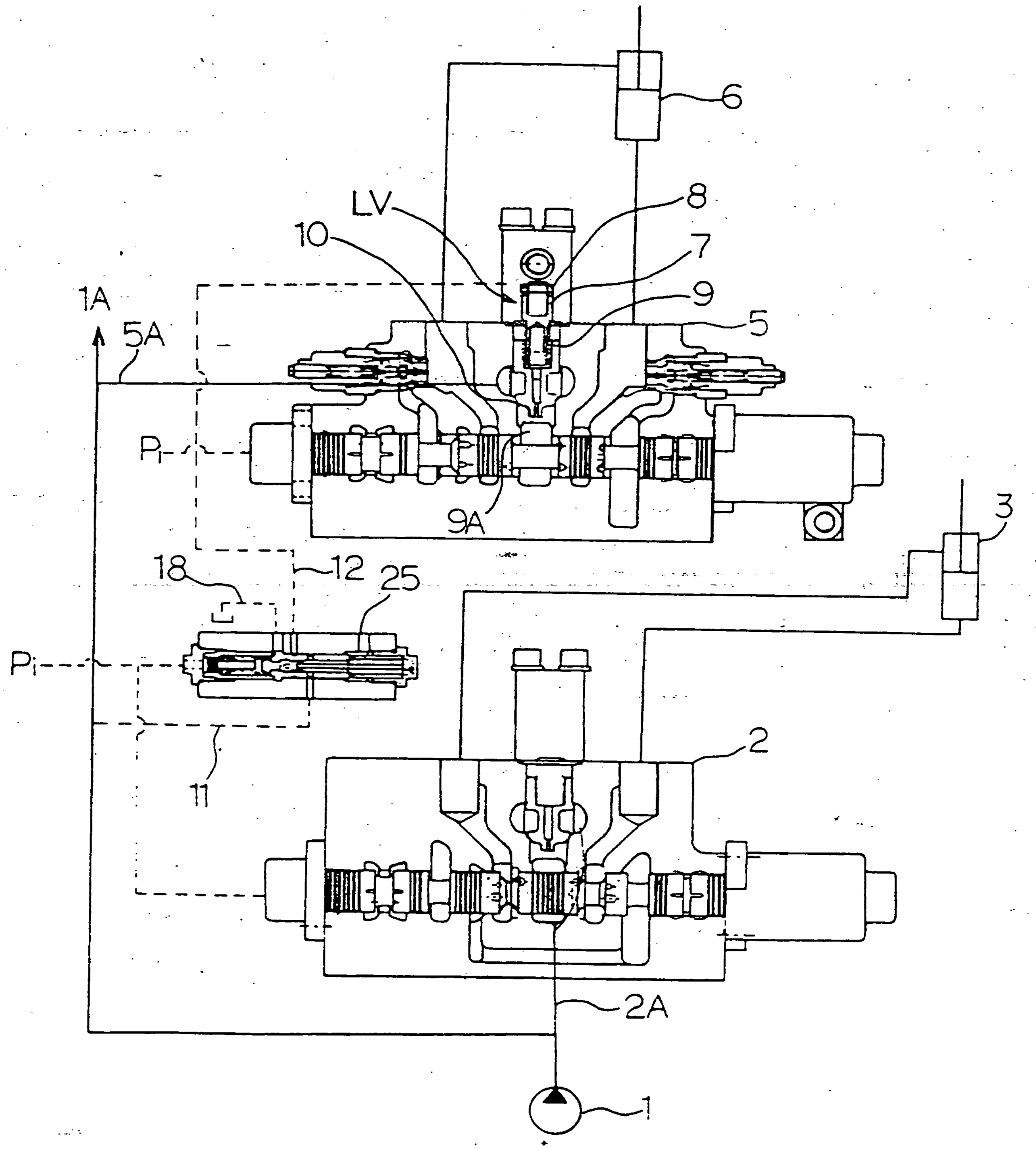


FIG. 2

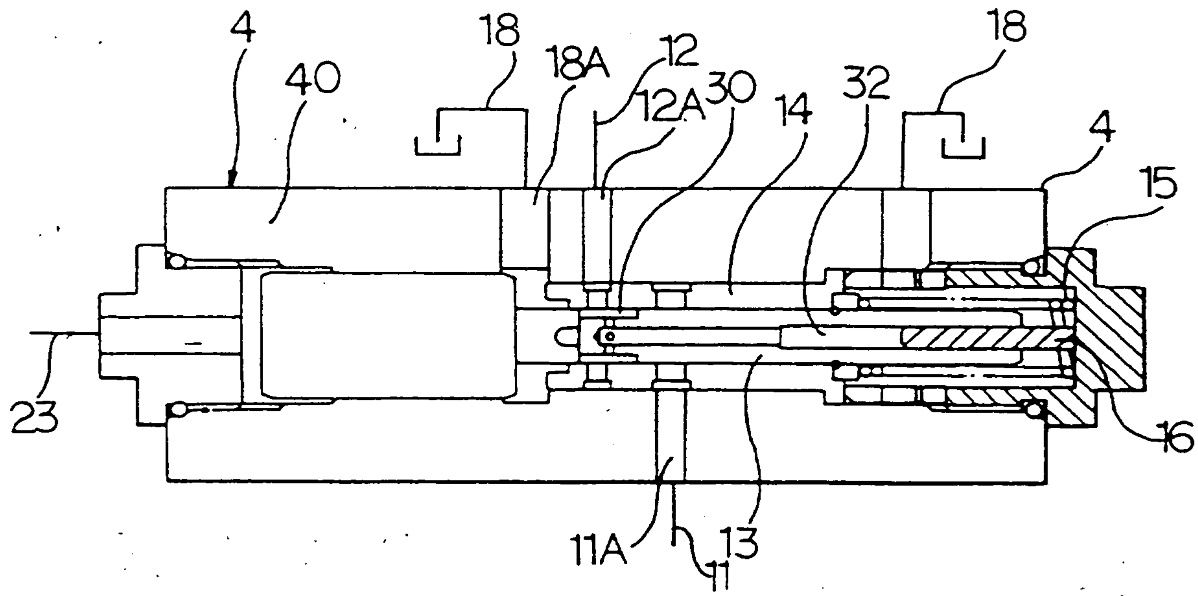

4
40
18
18A
12
12A
30
14
32
18
4
15
23
16
11A
13
11

FIG. 4

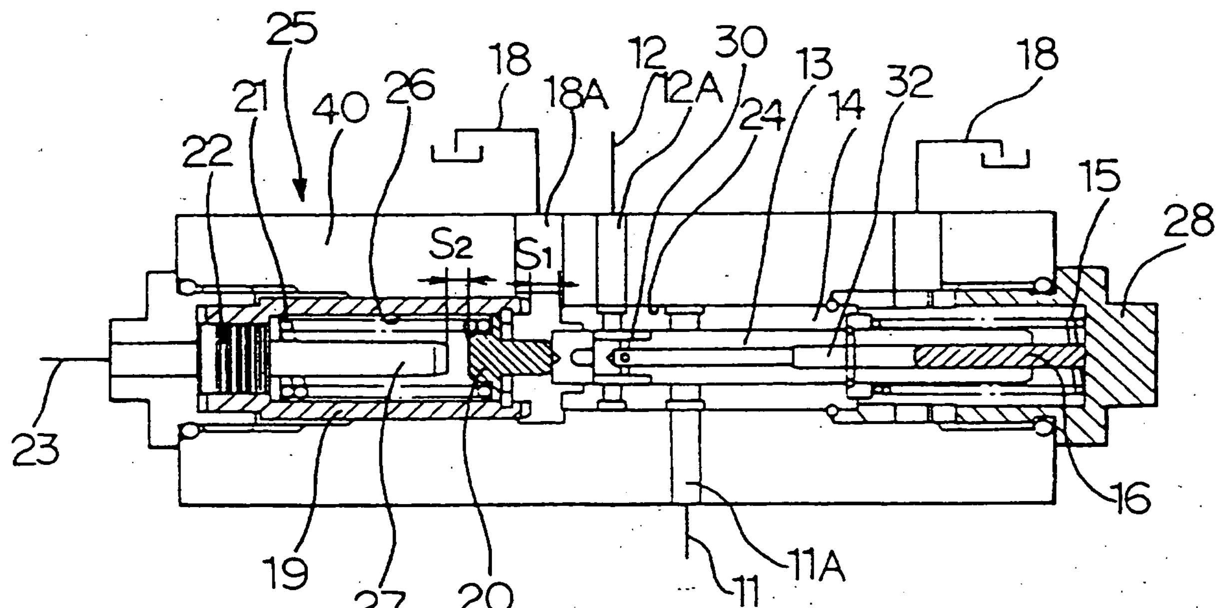

25
21
22
40
26
18
18A
12
12A
30
24
13
14
32
18
15
28
S2
S1
23
16
19
27
20
11
11A

FIG. 1

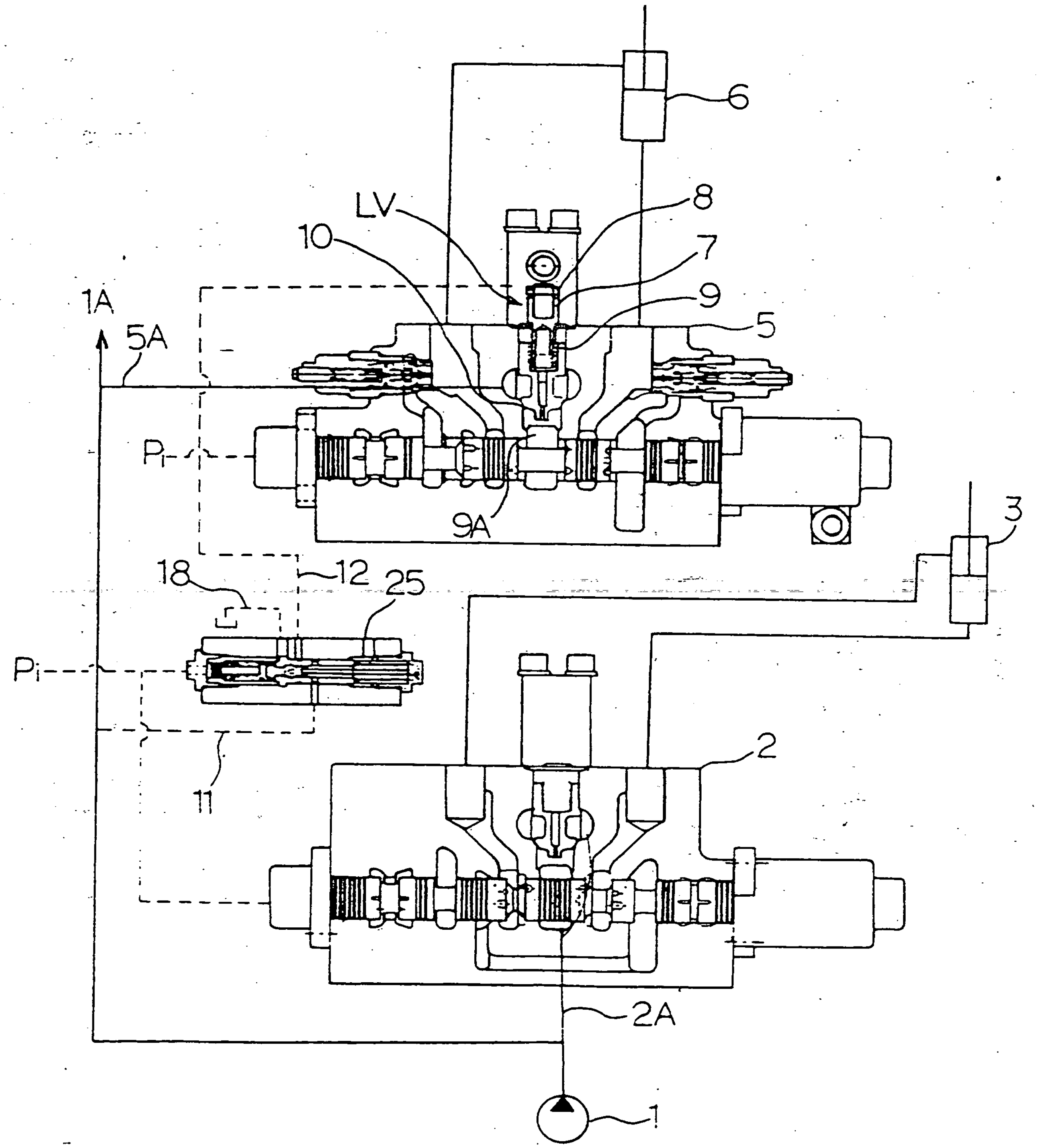


FIG. 2

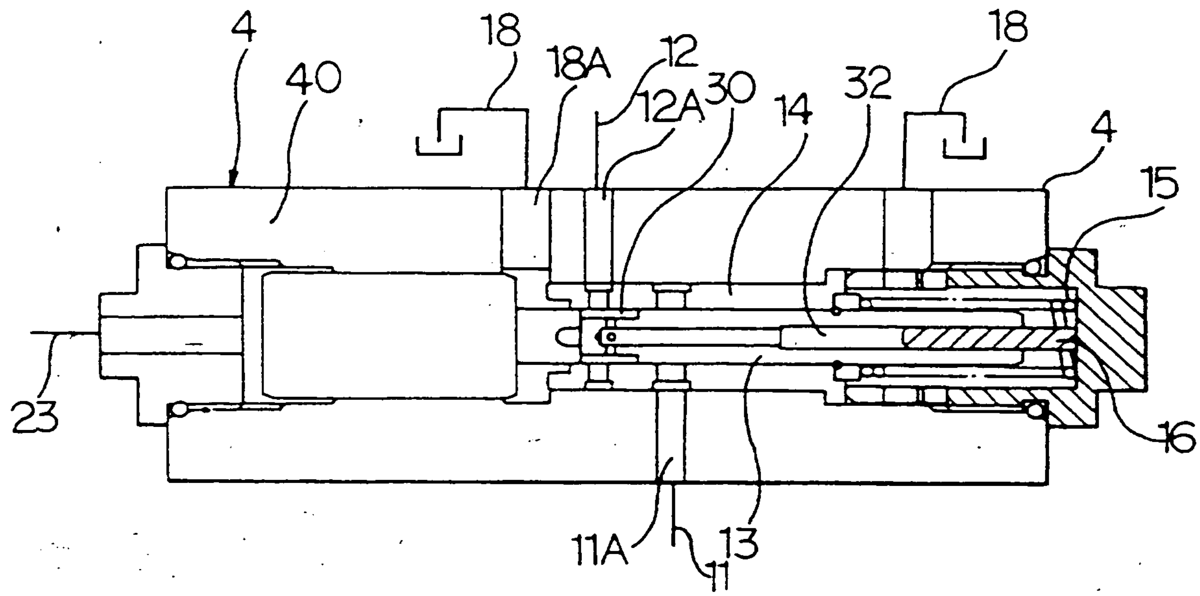

4
40
18
18A
12
12A
30
14
32
18
4
15
23
16
11A
13
11

FIG. 4

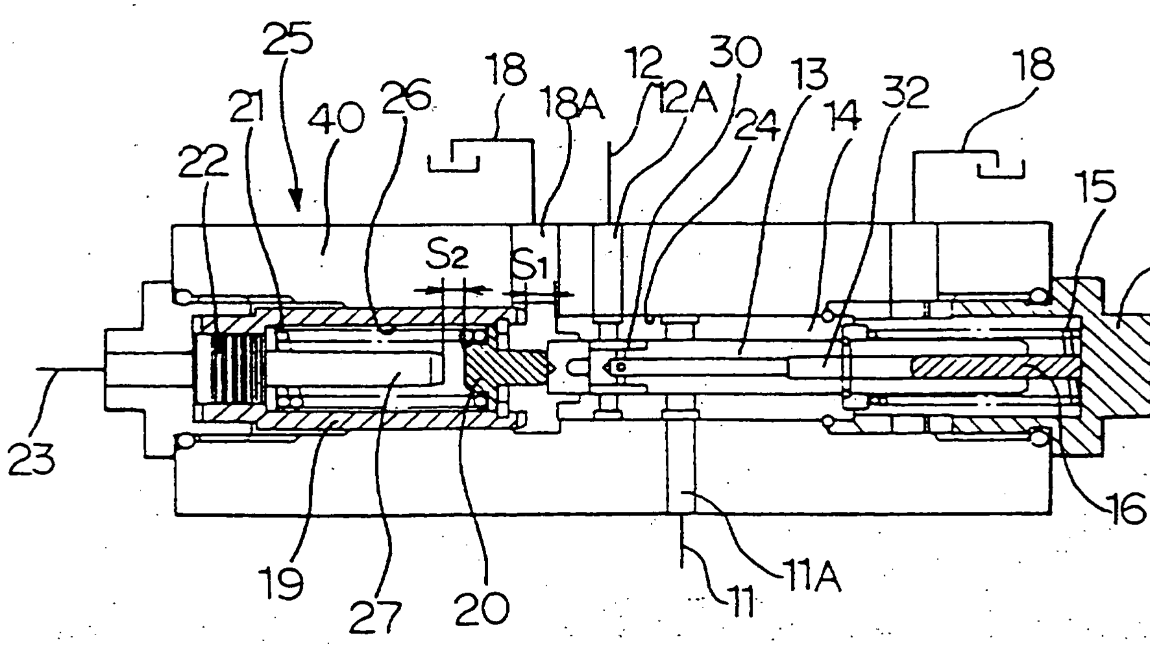

25
21
22
40
26
18
18A
12
12A
30
24
13
14
32
18
15
28
S2
S1
23
16
19
27
20
11A
11

FIG. 3

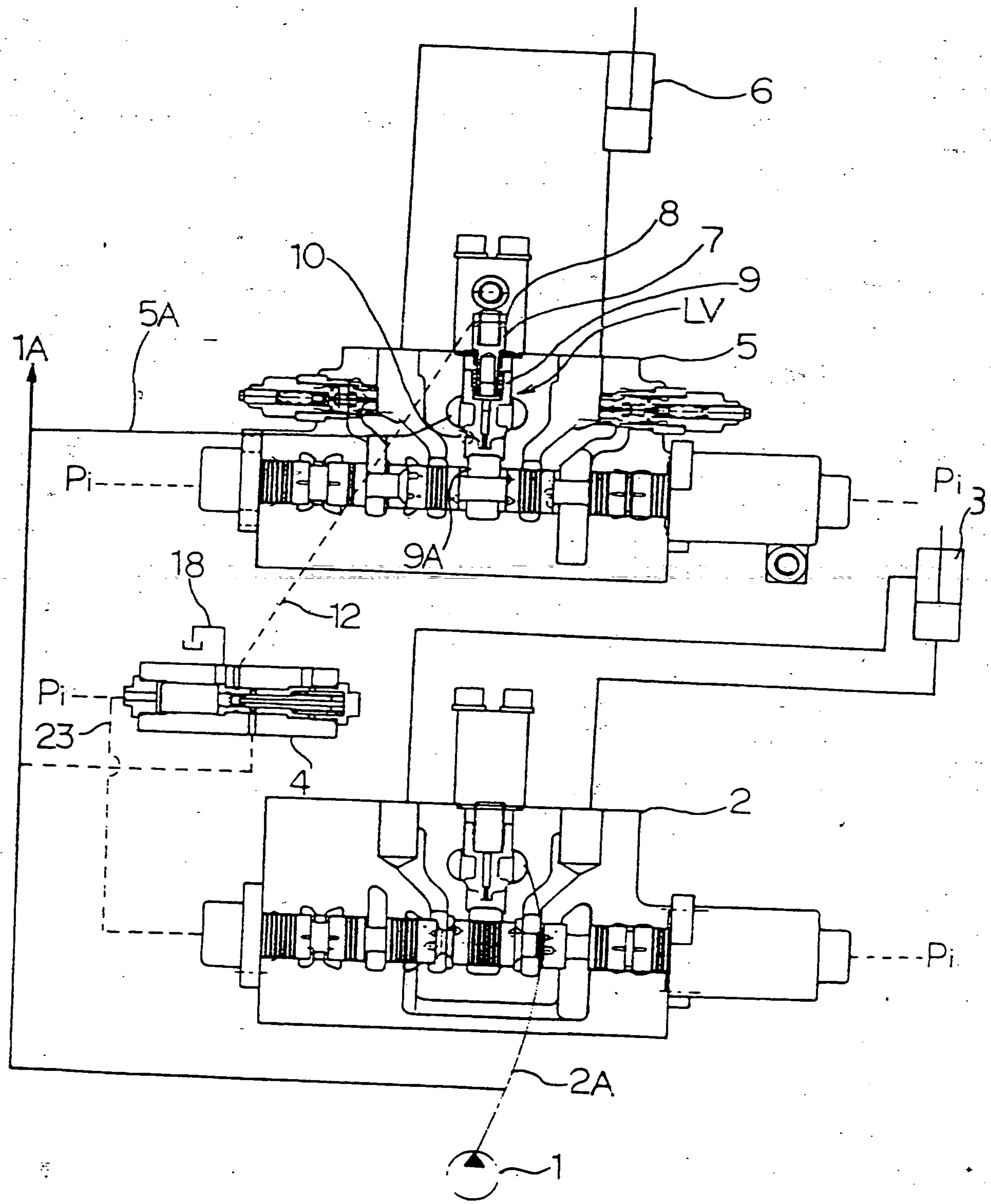


FIG.5A

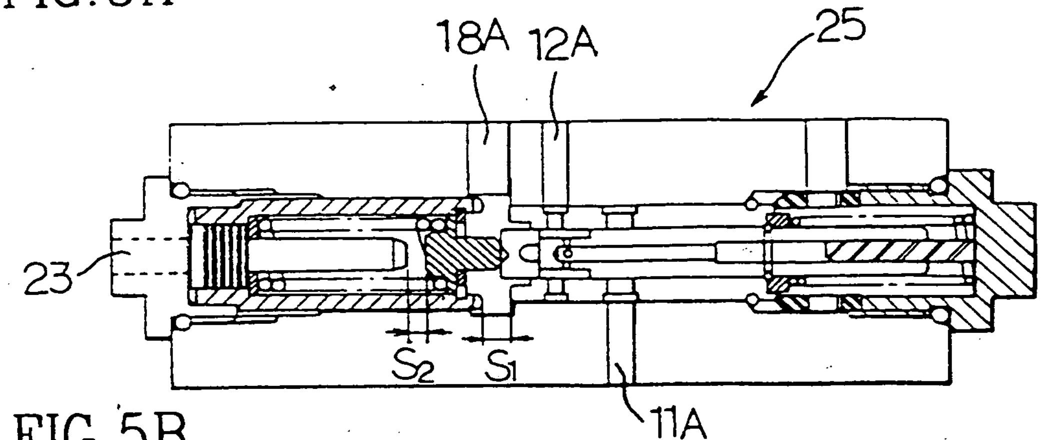


FIG.5B

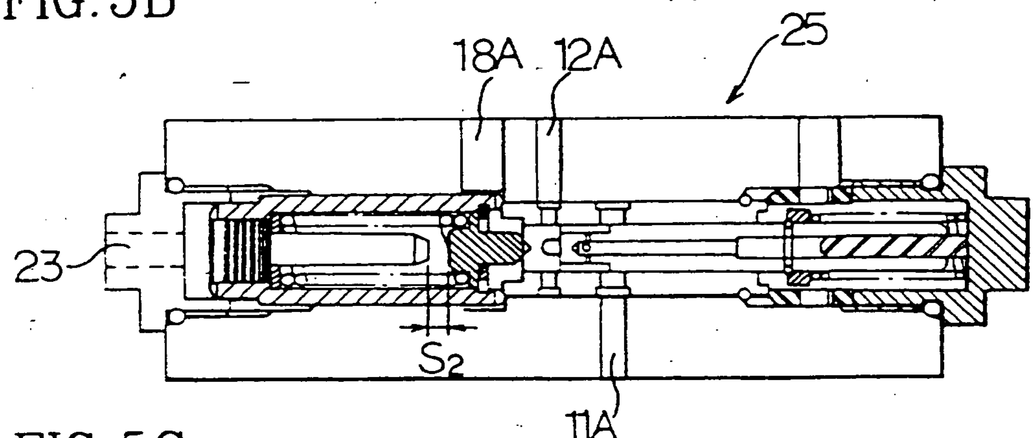


FIG.5C

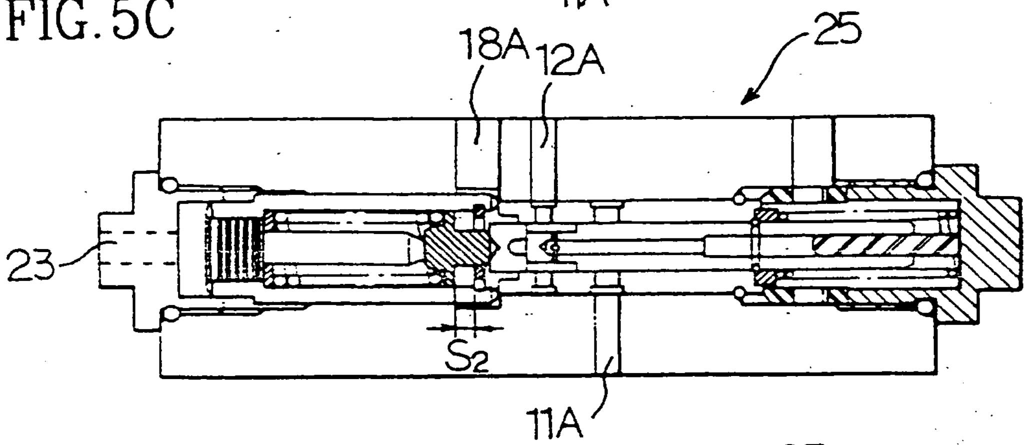


FIG.5D

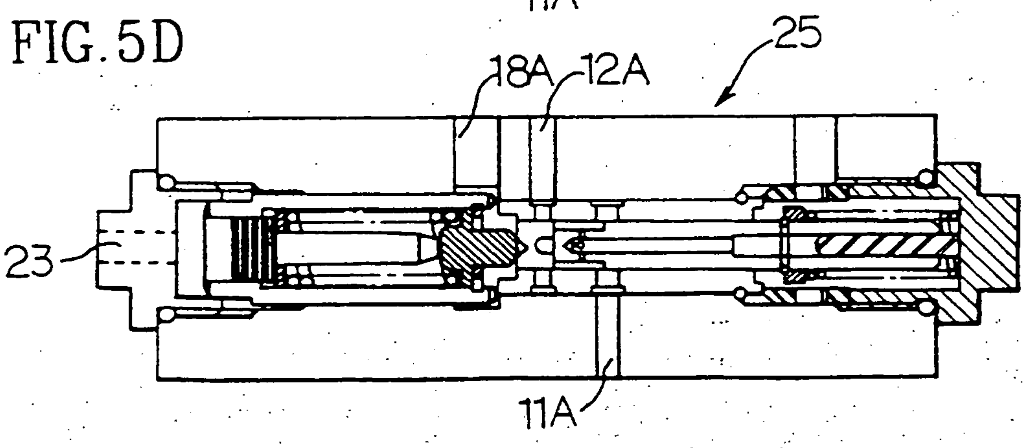
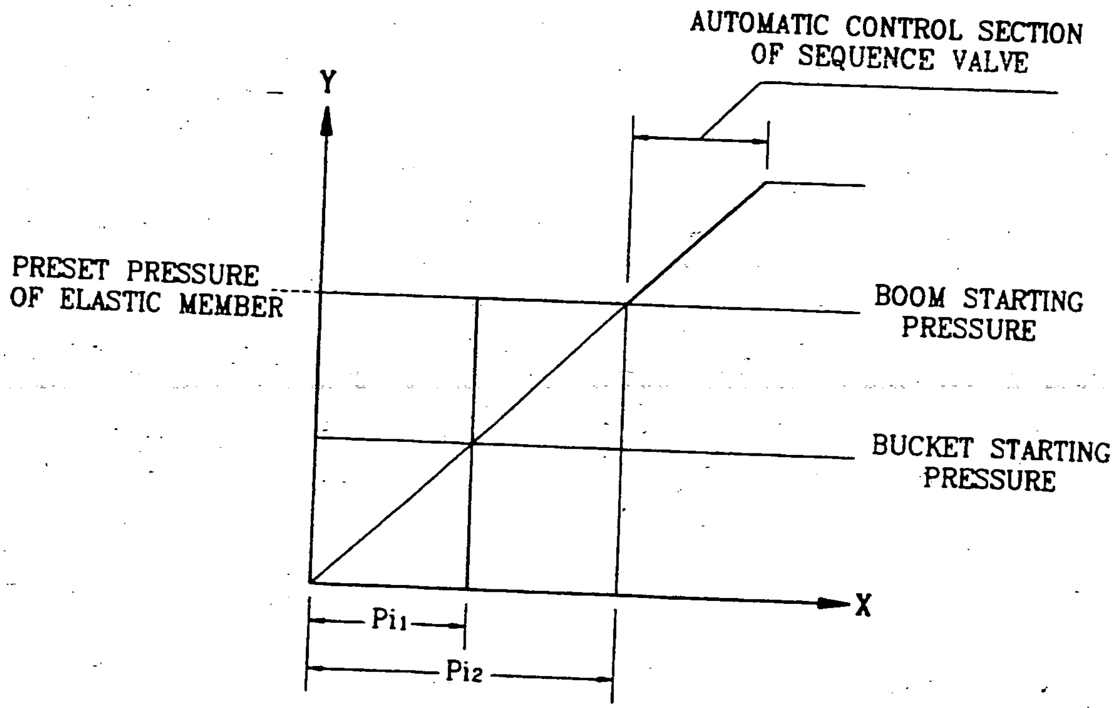


FIG. 6


AUTOMATIC CONTROL SECTION
OF SEQUENCE VALVE
Y
PRESET PRESSURE
OF ELASTIC MEMBER
BOOM STARTING
PRESSURE
BUCKET STARTING
PRESSURE
X
Pi1
Pi2

VARIABLE PRIORITY DEVICE FOR HYDRAULIC SYSTEM OF CONSTRUCTION EQUIPMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates, in general, to a variable priority device used in a hydraulic system of construction equipment with a plurality of actuators being commonly operated by pressurized oil discharged from a single pump and, more particularly, to a variable priority device with a sequence valve capable of sensing the pilot pressure for a high-load actuator control valve and controlling the orifice area of a logic valve by the feedback pressure of the pump discharged oil and reducing the delay time between the starting of a low-load actuator and the starting of the high-load actuator thus allowing the two actuators to be started almost simultaneously.

2. Description of the Prior Art

In a hydraulic system with a single pump for construction equipment, "priority" means that the system, with high-load and low-load actuators being operated at the same time, is automatically controlled to allow a larger amount of pump discharged oil to be fed to the high-load actuator prior to the low-load actuator. For example, priority in a hydraulic system for power excavators includes "swing prior to arm", "boom prior to bucket", etc. Such a priority is performed to feed a larger amount of discharged oil to the swing motor

(high-load actuator) prior to the arm cylinder (low-load actuator) and to feed a larger amount of oil to the boom cylinder (high-load actuator) prior to the bucket cylinder (low-load actuator). That is, a priority device included in a hydraulic system differentially feeds the pump discharged oil to the high-load and low-load actuators, thus operating the high-load actuator in proportion to the moving speed of the low-load actuator and smoothly operating the two actuators.

In order to provide such a priority device on an oil passage for the boom and bucket actuators of a power excavator, a fixed orifice is mounted to the oil passage for the bucket cylinder (low-load actuator). However, such a fixed orifice is problematic in that it causes a pressure loss when the bucket cylinder is operated alone with the boom cylinder being stopped. In this case, the bucket cylinder fails to effectively use the pump discharged oil and reduces its operational effect.

In an effort to overcome the above problem, a variable priority device with a sequence valve is proposed. The above variable priority device automatically controls the amount of oil for a low-load actuator in accordance with the difference of pressure between the loaded pressures of high-load and low-load actuators.

A typical variable priority device for a power excavator is shown in Fig. 1. As shown in the drawing, a main passage 1A, extending from an oil pump 1, is branched into two parallel passages 2A and 5A for boom and bucket cylinders 3 and 6. A boom control valve 2 is mounted to the first parallel passage 2A for the boom cylinder 3, while

a bucket control valve 5 is mounted to the second parallel passage 5A for the bucket cylinder 6. Installed in the input passage 9A of the bucket control valve 5 are a vertically movable piston 7, a load check 9 and a logic valve LV. The logic valve LV has a piston pressure chamber 8, which is formed by an output oil passage 12 at a position above the piston 7. An orifice 10 is provided in the valve 5 at a position between the lower end of the load check 9 and the input passage 9A. The opening area of the orifice 10 is variable in accordance with a pressure variation inside the pressure chamber 8. A sequence valve 4 is connected to the pressure chamber 8 of the valve 5 so as to feed pump discharged oil to the chamber 8.

As shown in Fig. 2, the output oil port 12A of the sequence valve 4 is connected to the output oil passage 12 which extends to the chamber 8 of the valve 5, while the drain port 18A of the valve 4 is connected to a return tank (not shown) through a return passage 18. The pump port 11A of the valve 4 is connected to the input oil passage 11 which is branched from the main passage 1A. A sleeve 14 is received in the housing 40 of the valve 4. A pilot piston 17 is movably received in the housing 4 so that the piston 17 is movable to the left or right in accordance with the pilot pressure Pi for the boom control valve 2. In order to allow the pilot pressure Pi to be applied to the pilot piston 17, a pilot passage 23 is branched from a pilot passage for the boom control valve 2 and is connected to the sequence valve 4. A spool 13 is received in the sleeve 14, with one end of the spool 13 being normally biased by a return spring 15 and the other

end being brought into contact with the pilot piston 17 thus being selectively biased by the piston 17. The spool 13 has an internal passage 30. The internal passage 30 of the spool 13 allows the pump port 11A to selectively communicate with the output oil port 12A. A longitudinal chamber 32 is formed in the center of the spool 13 and communicates with the internal passage 30. A longitudinal protrusion 16 is interiorly formed on one end of the housing 40 and is movably received in the chamber 32 thus allowing the spool 13 to be longitudinally movable relative to the protrusion 16.

When it is necessary to perform a boom-up action along with a bucket-in action, a pilot pressure Pi for starting the boom control valve 2 is applied to the pilot piston 17 of the sequence valve 4 through the pilot passage 23, thus pushing the pilot piston 17 to the right in Fig. 2. The pilot piston 17 in the above state pushes the spool 13 to the right in the drawing while overcoming the biasing force of the return spring 15, thus allowing the pump port 11A of the valve 4 to communicate with the output oil port 12A through the internal passage 30. Therefore, pressurized oil is fed to the output port 12A and increases pressure of the piston pressure chamber 8 so that both the piston 7 and the load check 9 of the control valve 5 are lowered. The opening area of the orifice 10 is thus reduced, causing a reduction of the amount of pump discharged oil for the bucket control valve 5 with the amount of oil for the boom cylinder 6 being increased.

In the graph of Fig. 6, the x-axis represents a pilot pressure Pi for the sequence valve 4, while the y-axis represents a pressure acting on

the output port 12A of the sequence valve 4 or a pressure of the piston pressure chamber 8. As represented in the graph of Fig. 6, when the initial pilot pressure Pi increases, the spool 13 moves to the right thus causing the output port 12A to communicate with the pump port 11A through the internal passage 30 and linearly increasing the pressure of the output oil passage 12. Since the internal passage 30 communicates with the longitudinal chamber 32 in the above state, the pressure of the pump port 11A is applied into the chamber 32. The force balance of the sequence valve 4 in the above state is represented by the following expression (1) with A_1 (sectioned area of the pilot piston 17), A_2 (sectioned area of the chamber 32), Pi (pilot pressure), P_1 (pressure of the longitudinal chamber 32) and Fs_1 (biasing force of the return spring 15):

$$PiA_1 = P_1A_2 + Fs_1 \quad \text{------} \quad (1)$$

In the above expression (1), the left side denotes a force for biasing the spool 13 to the right, while the right side denotes a force for biasing the spool 13 to the left. Fs_1 is a constant so that when Pi increases with P_1 being constant, the spool 13 proportionally moves to the right thus linearly enlarging the opening area of the pump port 11A. Therefore, the actuating pressure of the output port 12A varies through the line A of the graph of Fig. 6. In the graph of Fig. 6, Pi_1 denotes a pilot pressure for starting the bucket cylinder 6, while Pi_2 denotes a pilot pressure for starting the boom cylinder 3.

However, in a mode with the bucket and boom cylinders being operated at the same time, the hydraulic system cannot perform a boom-up action but only performs a bucket-in action within a pilot pressure section between Pi_1 and Pi_2 due to the pressure difference between the lower pressure Pi_1 for the bucket cylinder 6 and the higher pressure Pi_2 for the boom cylinder 3. That is, within the above pilot pressure section, the bucket and boom cylinders are not started at the same time but are separately started with a delay time, thus failing to effectively perform a desirable work, deteriorating the operational sense, and reducing work efficiency of construction equipment.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art. An object of the present invention is to provide a variable priority device for a hydraulic system of construction equipment, which senses the pilot pressure for a high-load actuator control valve and applies a control pressure to a logic valve so_as to temporarily stop a low-load actuator until the pilot pressure reaches a preset pressure capable of starting a high-load actuator.

Another object of the present invention is to provide a variable priority device for hydraulic system of construction equipment, which controls the orifice area of a logic valve by feedback pressure and reduces the delay time between the starting of a low-load actuator and the starting a high-load actuator, thus allowing the two actuators to be started almost simultaneously and improving work efficiency of the construction equipment.

In order to accomplish the above objects, the present invention provides a variable priority device for a hydraulic system of construction equipment, comprising a high-load actuator and a low-load actuator to be commonly operated by pump discharged oil of a single pump, and a logic valve installed in an input oil passage of a low-load actuator control valve and adapted for selectively closing the input oil passage in response to a signal, further comprising: a sequence valve sensing a pilot pressure for a high-load actuator control

valve and outputting a signal formed by a feedback pressure of the pump discharged oil thus controlling the orifice area of the logic valve.

The sequence valve comprises: a housing longitudinally holed at the center thus forming a center opening and transversely holed at several positions thus forming a pump port, an output port and a drain port, the pump port being connected to the pump and the output port being connected to the logic valve; a pilot piston movably received in one end of the center opening of the housing and having a longitudinal opening, one end of the pilot piston communicating with a pilot passage for the high-load actuator control valve thus allowing the pilot pressure for the high-load actuator control valve to be applied to the pilot piston; a center piston movably received in one end of the longitudinal opening of the pilot piston and having a fixed piston rod; a guide movably received in the other end of the longitudinal opening of the pilot piston and axially projecting into the exterior of the pilot piston; means for sensing the pilot pressure for the high-load actuator control valve, the pilot pressure sensing means being positioned in the longitudinal opening of the pilot piston; a sleeve fixedly received in the other end of the center opening of the housing, the sleeve having a plurality of ports communicating with the pump port, output port and drain ports of the housing respectively; a spool movably received in the sleeve, one end of the spool being brought into contact with the guide and the other end being biased by a return spring; an internal passage formed on one end of the spool, the internal passage connecting the pump port to the drain port at an initial position of the

spool and connecting the pump port to the output port in place of the drain port with the spool being moved by the pilot pressure acting on the pilot piston; a plug fixedly mounted to the other end of the center opening of the housing and holding the return spring; and a feedback means for returning the spool to its initial position while overcoming the pilot pressure.

The pilot pressure sensing means comprises: an elastic member interposed between the center piston and the guide, both ends of the elastic member biasing both the center piston and the guide in opposite directions thus retaining both the center piston and the guide at their stroke ending positions while spacing the piston rod apart from the guide at a predetermined interval.

The feedback means comprises: a longitudinal chamber formed in the spool and communicating with the internal passage; and a protrusion axially projecting from the inside end of the plug and movably inserted into the longitudinal chamber.

Biasing force of the elastic member is preset to be equal to an actuating force, the actuating force being generated by the pilot pressure acting on the pilot piston, when a pressure, operating the logic valve so as to limit the opening area of the input oil passage of the low-load actuator control valve thus starting the high-load and low-load actuators at the same time, acts on the output port.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a view showing the construction of a typical variable priority device for a power excavator;

Fig. 2 is a sectional view showing the construction of a sequence valve of the device of Fig. 1;

Fig. 3 is a view showing the construction of a variable priority device in accordance with the preferred embodiment of the present invention;

Fig. 4 is a sectional view showing the construction of a sequence valve of the variable priority device of Fig. 3;

Figs. 5a to 5d are views showing the operation of the sequence valve of Fig. 4; and

Fig. 6 is a graph showing pressure, acting on the output port of the sequence valve, as a function of pilot pressure for the sequence valve.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 shows the construction of a variable priority device in accordance with the preferred embodiment of this invention. Fig. 4 shows the construction of a sequence valve of the variable priority device of Fig. 3. Figs. 5a to 5d show the operation of the sequence valve of Fig. 4. Fig. 6 is a graph showing pressure, acting on the output port of the sequence valve, as a function of pilot pressure for the sequence valve.

As shown in Fig. 3, the variable priority device of this invention is preferably used with a hydraulic system for construction equipment such as power excavators, which has a high-load cylinder 3 and a low-load cylinder 6 to be operated by pressurized oil discharged from a single pump 1. A logic valve LV is mounted to an input passage 9A of a low-load cylinder control valve and selectively closes the passage 9A in response to a signal.

In the priority device of this invention, the construction and operation of the two actuators 3 and 6, two control valves 2 and 5 for controlling pump discharged oil for the two cylinders 3 and 6 and the logic valve LV installed in the passage 9A for the low-load cylinder 6 remain the same as those described for the prior art device of Figs. 1 and 2. Therefore, in Figs. 3 to 6 of this invention, the same members as those in the prior art device are denoted by the same reference numerals as those in the prior art device and further explanation is thus not deemed necessary.

The variable priority device of this invention has a sequence valve 25. The sequence valve 25 senses a pilot pressure Pi_1 acting on the high-load cylinder control valve 2 for starting the high-load cylinder 3, and outputs a signal for controlling the orifice area of the logic valve LV by feedback pressure P1.

As shown in Fig. 4, the sequence valve 25 has a housing 40. The housing 40 is longitudinally holed at the center thus forming a center opening 24. The housing 40 is also transversely holed at several positions thus forming a pump port 11A, an output port 12A and a plurality of drain ports 18A. The pump port 11A is connected to an input oil passage 11 extending from the pump 1 thus introducing pump discharged oil into the valve 25, while the output port 12A is connected to the piston pressure chamber 8 of the logic valve LV through an output oil passage 12. The sequence valve 25 also has a pilot piston 19, which is movably received in one end of the center opening 24 of the housing 40. The pilot piston 19 has a longitudinal opening 26 and communicates with a pilot passage 23. The pilot passage 23 is branched from a pilot passage for the high-load cylinder control valve 2 so that the pilot pressure P1 for the control valve 2 is also applied to the pilot piston 19. A piston 22 is movably received in one end of the opening 26 of the pilot piston 19 and has a fixed piston rod 27. A guide 20 is movably received in the other end of the opening 26 and axially projects into the exterior of the pilot piston 19. A pilot pressure sensing means is provided in the opening 26 and senses the pilot pressure Pi for the high-load cylinder 3. The

sequence valve 25 also has a sleeve 14, which is fixedly received in the other end of the opening 24 of the housing 40. The sleeve 14 has a plurality of ports, which communicate with the pump port 11A, output port 12A and drain ports 18A of the housing 40 respectively. The ports of the sleeve 14 are designated by the same reference numerals as those of the corresponding ports of the housing 40. A spool 13 is movably received in the sleeve 14, with one end of the spool 13 being brought into contact with the pilot piston 19 and the other end being biased by a return spring 15. The spool 13 has an internal passage 30 at one end. At the initial position of the spool 13, the internal passage 30 allows the pump and drain ports 11A and 18A of the valve 25 to communicate together. However, the internal passage 30 selectively connects the pump port 11A to the output port 12A in place of the drain port 18A, when the spool 13 moves in the sleeve 14 by the pilot pressure Pi acting on the pilot piston 19. A plug 28 is fixedly fitted into the other end of the center opening 24 of the housing 40 and holds the position of the return spring 15 in the housing 40. The sequence valve 25 further includes a feedback means, which returns the spool 13 to the initial position while overcoming the pilot pressure Pi.

The piston 22 is movable in the center opening 24 of the housing 40 within a stroke S1, while the guide 20 is movable in the longitudinal opening 26 of the pilot piston 19 within a stroke S2.

The pilot pressure sensing means comprises an elastic member 21, which is interposed between the piston 22 and the guide 20. Both

ends of the member 21 normally bias both the piston 22 and the guide 20 in opposite directions thus retaining both the piston 22 and the guide 20 at their stroke ending positions. The elastic member 21 also spaces the piston rod 27 apart from the guide 20 at a predetermined interval.

Biasing force of the elastic member 21 is preset to be equal to an actuating force F1. The actuating force F1 is generated by the pilot pressure Pi acting on the sectioned area of the pilot piston 19, when pressure, which operates the logic valve LV so as to limit the opening area of the input passage 9A of the low-load cylinder control valve 6 and start the high-load and low-load cylinders 5 and 6 at the same time, acts on the output port 12A of the sequence valve 25.

The biasing force of the elastic member 21 is higher than the biasing force of the return spring 15 so that when the pilot pressure Pi is applied to the sequence valve 25 through the pilot passage 23, the return spring 15 is compressed prior to the elastic member 21 thus allowing the spool 13 in the sleeve 14 to move to the right in the drawings.

The feedback means comprises a longitudinal chamber 32, which is formed in the spool 13 and communicates with the internal passage 30. The feedback means also has a protrusion 16, which axially projects from the inside end of the plug 28 and is movably inserted into the chamber 32 thus guiding movement of the spool 13.

The operational effect of the above variable priority device will be described hereinbelow.

The pressure, acting on the output port 12A of the sequence valve 25, varies sequentially through the following first to third stages in accordance with increase of the pilot pressure Pi applied to the sequence valve 25. In the first stage, the biasing force FS2 of the elastic member 21 is in balance with a reactive force Fr, which is formed by adding the pressure P1 acting on the chamber 32 to the biasing force FS1 of the return spring 15. In the second stage, the actuating force F2 generated by the pilot pressure Pi acting on the piston 22 is in balance with the above reactive force Fr. In the third stage, the biasing force FS2 of the elastic member 21 is in balance with the reactive force Fr, when the actuating force F2 is higher than the reactive force Fr.

The initial stage of the sequence valve 25 is changed into the first stage as follows. In the initial stage, the spool 13 is fully biased to the left by the return spring 15 thus being retained at its stroke ending state as shown in Fig. 5a. The spool 13 in the above state biases the guide 20 to the left thus retaining the pilot piston 19 at its stroke ending state and allowing the pump port 11A to communicate with the drain port 18A.

When the pilot pressure Pi for the high-load cylinder control valve 2 is applied to the sequence valve 25 in the initial stage through the pilot passage 23, the actuating force F1, which is formed by multiplying the sectional area A1 of the pilot piston 19 by the pilot pressure Pi, becomes higher than the reactive force Fr or the biasing force FS1 of the return spring 15 so that both the pilot piston 19 and

the spool 13 move to the right within the stroke S1 as shown in Fig. 5b. In the above state, the biasing force FS2 of the elastic member 21 is higher than the biasing force FS2 of the return spring 15 so that the return spring 15 fails to compress the elastic member 21. When the spool 13 moves to the right as described above, the pump port 11A communicates with the internal passage 30 which allows the pump port 11A to communicate with the output port 12A in place of the drain port 18A. The pump pressure P1 of the pump port 11A is applied to the chamber 32 which communicates with the internal passage 30. In this state, the reactive force Fr acting on the spool 13 is formed by adding the actuating force F2, which is formed by multiplying the sectioned area A2 of the chamber 32 by the pump pressure P1, to the biasing force FS1 of the return spring 15. When the reactive force Fr is higher than the biasing force FS1 of the elastic member 21, the spool 13 pushes the guide 20 to the left by a distance S2 until the guide 20 is stopped by the rod 27 of the piston 22 as shown in Fig. 5c. The above operation of the valve 25 is performed with the pilot pressure Pi increasing to make the actuating force F1 higher than the biasing force FS1 of the elastic member 21. That is, when the actuating force F1 is lower than the biasing force FS1, the pilot piston 19 will move to the left in the drawings.

The force balance in the above state with both the elastic member 21 being compressed and the spool 13 being pushed to the left is represented by the following expression (2).

$$FS1 = FS2 + P1A2 \quad \text{-----} \quad (2)$$

In the above expression (2), the biasing force FS1 of the elastic member 21 is lower than PiA1 so that the pump pressure P1 acts as a variable. The pump pressure P1 is in proportion to the opening areas of both the pump port 11A and the internal passage 30. Therefore, when the pump pressure P1 is constant, it is possible to determine a position of the spool 13 at which the internal passage 30 of the spool 13 has an opening area allowing the right side of the expression (2) to be equal to the left side.

When the pump pressure P1 increases, the right side (FS2 +P1A2) of the expression (2) becomes higher than the left side (FS1) so that the spool 13 moves to the left thus reducing the opening area of the internal passage 30 to a minimum area. In the above state, the guide 20 directly moves from the position of Fig. 5a into the position of Fig. 5c without passing the position of Fig. 5b so that the sequence valve 25 reduces the delay time between the starting of the high-load cylinder and the starting of the low-load cylinder and allows the two cylinders to be started almost simultaneously. When the biasing force FS1 of the elastic member 21 in the above state is preset to be equal to the pilot pressure Pi for starting the high-load cylinder 3, the pressure acting on the output port 12A at the pilot pressure Pi_1 rapidly increases to the preset biasing force FS1 of the elastic member 21 so that the line B in the graph of Fig. 6 extends in parallel to the y-axis.

The first stage of the sequence valve 25 is changed into the second stage as follows. When the pilot pressure Pi of the first stage continuously increases and allows the actuating force F1 to be equal to the biasing force FS1 of the elastic member 21, the actuating force F2 formed by the pilot pressure Pi acting on the sectioned area A3 of the piston 22 is equal to the reactive force Fr within the pilot pressure section between Pi_1 and Pi_2 as shown in the graph of Fig. 6. The force balance in the second stage is represented by the expression (3).

$$PiA3 = P1A2 + FS2 \quad ---- \quad (3)$$

The above expression (3) represents that the actuating force F2 or PiA3 at the pilot pressure Pi_2 is equal to the reactive force Fr or (PiA2 + FS2). Within the above pilot pressure section between Pi_1 and Pi_2, the spool 13 stops without moving in either direction.

The second stage of the sequence valve 25 is changed into the third stage as follows. The pilot pressure Pi continuously increases thus allowing the actuating force Fs of the left side of the expression (3) to be higher than the reactive force Fr of the right side. In this case, the piston 22 moves to the right while sliding on the internal wall of the opening 26 of the pilot piston 19 so that the guide 20 along with the rod 27 moves to the right within the stroke S2 thereby pushing the spool 13 to the right. The opening area between the pump port 11A and the output port 12A is thus enlarged and increases the pressure of the output port 12A. When the pressure of

the output port 12A increases as described above, the reactive force Fr increases and overcomes the actuating force F2 thus moving the spool 13 to the left. The spool 13 is to continuously move so as to allow the actuating force F2 to be equal to the reactive force Fr. Therefore, the position of the spool 13 is automatically controlled by both the feedback pilot pressure Pi and the feedback pump pressure P1 of the output port 12A, the two feedback pressures Pi and P1 acting as variables while the sequence valve 25 changes its position from the position of Fig. 5C to the position of Fig. 5d with the guide 20 moving to the stroke S2.

As described above, the present invention provides a variable priority device for hydraulic system of construction equipment. The device senses the pilot pressure for a high-load actuator control valve and applies a control pressure to a logic valve so as to temporarily stop a low-load actuator until the pilot pressure reaches a preset pressure capable of starting a high-load actuator. The variable priority device also controls the orifice area of the logic valve by feedback pressure and reduces the delay time between the starting of the low-load actuator and the starting of the high-load actuator, thus allowing the two actuators to be started almost simultaneously and improving work efficiency of the construction equipment.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention

as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A variable priority device for a hydraulic system of construction equipment, comprising a high-load actuator and a low-load actuator to be commonly operated by pump discharged oil of a single pump, and a logic valve installed in an input oil passage of a low-load actuator control valve and adapted for selectively closing said input oil passage in response to a signal, further comprising:

a sequence valve sensing a pilot pressure for a high-load actuator control valve and outputting a signal formed by a feedback pressure of the pump discharged oil thus controlling the orifice area of said logic valve.

2. The variable priority device according to claim 1, wherein said sequence valve comprises:

a housing longitudinally holed at the center thus forming a center opening and transversely holed at several positions thus forming a pump port, an output port and a drain port, said pump port being connected to the pump and said output port being connected to the logic valve;

a pilot piston movably received in one end of said center opening of the housing and having a longitudinal opening, one end of said pilot piston communicating with a pilot passage for the high-load actuator control valve thus allowing the pilot pressure for the high-load actuator control valve to be applied to the pilot piston;

a center piston movably received in one end of said longitudinal opening of the pilot piston and having a fixed piston rod;

a guide movably received in the other end of said longitudinal opening of the pilot piston and axially projecting into the exterior of the pilot piston;

means for sensing the pilot pressure for the high-load actuator control valve, said pilot pressure sensing means being positioned in the longitudinal opening of the pilot piston;

a sleeve fixedly received in the other end of said center opening of the housing, said sleeve having a plurality of ports communicating with said pump port, output port and drain ports of the housing respectively;

a spool movably received in said sleeve, one end of the spool being brought into contact with said guide and the other end being biased by a return spring;

an internal passage formed on one end of said spool, said internal passage connecting said pump port to the drain port at an initial position of the spool and connecting the pump port to the output port in place of the drain port with the spool being moved by the pilot pressure acting on the pilot piston;

a plug fixedly mounted to the other end of the center opening of the housing and holding the return spring; and

a feedback means for returning said spool to its initial position while overcoming the pilot pressure.

3. The variable priority device according to claim 2, wherein said pilot pressure sensing means comprises:

an elastic member interposed between the center piston and the guide, both ends of the elastic member biasing both the center piston and the guide in opposite directions thus retaining both the center piston and the guide at their stroke ending positions while spacing the piston rod apart from the guide at a predetermined interval.

4. The variable priority device according to claim 2, wherein said feedback means comprises:

a longitudinal chamber formed in said spool and communicating with said internal passage; and

a protrusion axially projecting from the inside end of said plug and movably inserted into said longitudinal chamber.

5. The variable priority device according to claim 3, wherein biasing force of the elastic member is preset to be equal to an actuating force, said actuating force being generated by the pilot pressure acting on the pilot piston, when a pressure, operating the logic valve so as to limit the opening area of said input oil passage of the low-load actuator control valve thus starting the high-load and low-load actuators at the same time, acts on said output port.

The Patent Office

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Application No: GB 9714826.6
Claims searched: 1 to 5

Examiner: Trevor Berry
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F1P, G3P(PPSX)

Int Cl (Ed.6): E02F, F15B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.